Notes on the Natural History of Stylites gemmifera

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Several unexpected observations were made recently while collecting plants of *Stylites* E. Amstutz for anatomical study. The plants were collected near the end of the growing season (18–19 April 1979) so as to obtain young plants which had just completed various numbers of growing seasons. In the type locality, *Stylites* is described as forming pure colonies which stand just above the water level in the lacustrine bog in which they are found (Rauh & Falk, 1959); but the plants we collected at 4100 m altitude (*Karrfalt & Hunter* 22, NY) near Lago Junín, 14 km north of Junín, Peru, were invariably growing in association with various flowering plants (*Figs. 1* and *2*) and were frequently submerged. The colonies at the Junín locality were generally in the form of radially symmetrical, dome-shaped hummocks (*Fig. 1*), but various other rounded shapes occurred as well. The hummocks ranged in diameter from 20 to about 200 cm. The larger hummocks generally were found to contain a larger proportion of other plants in addition to *Stylites* than did the smaller ones. The plants in the hummocks were extremely densely packed and usually stood above the water level, but some hummocks were partially or completely submerged. The submerged portions of these hummocks were populated nearly exclusively by *Stylites*, but the emergent portions included other plants as well (*Fig. 5*). These plants usually were rather small (with stems a few millimeters in length), but some were quite good-sized (stems 2–4 cm long) and bore about 40 leaves up to 7 cm long, as well as numerous gemmae. Their leaves did not have the typical flattened form with deflexed tips, but rather were subtriangular to terete in cross section and ascending. All intermediate forms between these atypical leaves and those described by Rauh and Falk (1959) were also seen; the variation in leaf morphology will be described in detail in a subsequent report. The plants with the atypical leaf form always were submerged and not densely crowded. On the other hand, plants bearing typical leaves occurred both above and below the water level in the bog, but these plants always were densely crowded. Leaf form correlates with population density rather than with emergence or submergence. The nature of this correlation is not certain, but experiments in progress suggest that it is largely or entirely environmental.

In contrast to its very limited geographical range, *Stylites* is extremely vigorous and abundant where appropriate conditions for its growth exist. The Junín locality is a bog which has been used as a pasture for many years. It is heavily grazed by sheep and llamas, as indicated by the cropped herbage (*Figs. 1* and *4*) and abundant llama dung. The *Stylites* plants, however, very rarely show any evidence of even accidental damage by the animals. The Junín locality occupies at least several acres; we were unable to determine its full extent due to our anoxemia and consequent lack of energy.

The leaves of *Stylites* are coated with considerable quantities of mucilage, as are the basal parts of the leaves of all *Isoëtes* species of which we have seen living

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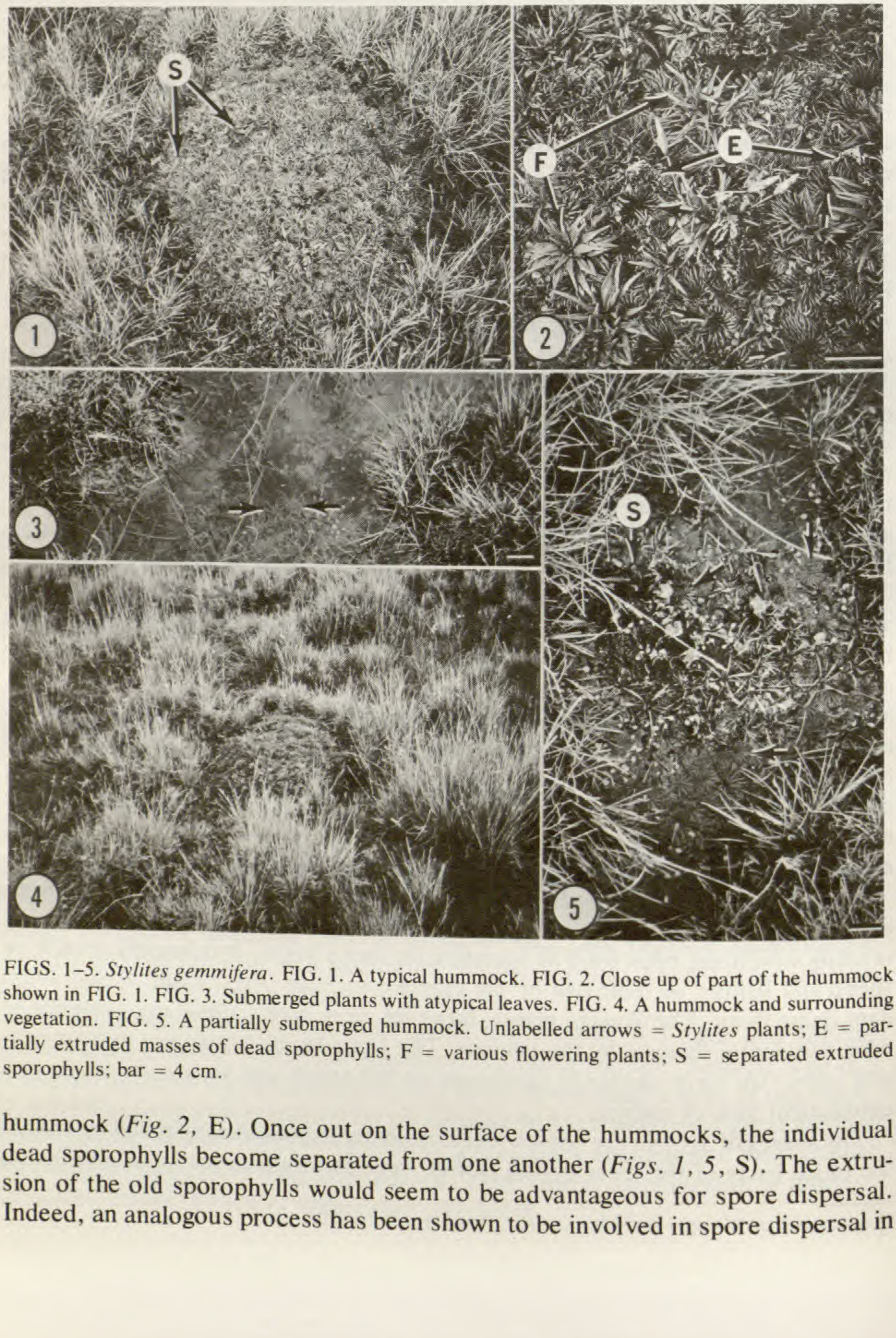
material. Also as in *Isoëtes*, the leaves are replaced annually (Rauh & Falk, 1959). As the new leaves grow and expand within the hummock, the dead, mucilage-coated leaves of the largest plants are extruded *en masse* onto the surface of the



FIGS. 1–5. *Stylites gemmifera*. FIG. 1. A typical hummock. FIG. 2. Close up of part of the hummock shown in FIG. 1. FIG. 3. Submerged plants with atypical leaves. FIG. 4. A hummock and surrounding vegetation. FIG. 5. A partially submerged hummock. Unlabelled arrows = *Stylites* plants; E = partially extruded masses of dead sporophylls; F = various flowering plants; S = separated extruded sporophylls; bar = 4 cm.

hummock (*Fig. 2*, E). Once out on the surface of the hummocks, the individual dead sporophylls become separated from one another (*Figs. 1, 5*, S). The extrusion of the old sporophylls would seem to be advantageous for spore dispersal. Indeed, an analogous process has been shown to be involved in spore dispersal in

Isoëtes drummondii (Osborn, 1922). However, examination of large numbers of extruded sporophylls of *Stylites* never revealed any discernible evidence of the establishment of gametophytes by the spores carried with the extruded sporophylls. Field observations of gametophytes were necessarily limited to those which could be made with a hand lens; that is, only megaspores were examined and these only for the opening of the trilete scar. Any megagametophytes which were contained within unopened spore walls were not distinguished from ungerminated spores.

Rauh and Falk (1959) found very few megagametophytes and no microgametophytes of *Stylites*. In our material, gametophytes were likewise very infrequently encountered. Only megagametophytes were identified in the field and these were found only in association with adult sporophytes which showed some evidence of recent damage or injury, such as relatively few leaves or a reduced stem diameter near the apex. Six gametophytes were found, all of which bore sporophytes with one or two leaves and roots. The occurrence of the rare megametophytes only in association with the rare, injured sporophytes suggests that the absence of gametophytes from other locations is the result of unequal competition between the gametophytes and the much larger, densely crowded adult sporophytes and gemmae.

It was not possible to determine the specific source of the spores which gave rise to the gametophytes we collected. Our gametophytes were probably derived from the massive quantities of spores produced by the immediately adjacent sporophytes, but the possibility cannot be excluded that the successful spores may be have been transported with old sporophylls which had been extruded onto the surface of the same or some other hummock.

Many of the plants which we collected bore abundant gemmae and therefore must be assigned to *S. gemmifera* W. Rauh, inasmuch as *S. andicola* E. Amstutz has no vegetative reproduction. The other criteria by which Rauh and Falk (1959) distinguished the sporophytes of *S. andicola* from those of *S. gemmifera* are merely quantitative and are of questionable value. For example, the leaves of *S. andicola* are said to be 5–7 cm long, whereas those of *S. gemmifera* are said to be 3.5–5 cm long, but as noted above some gemma-bearing plants in our collection had leaves as long as 7 cm. Although these longest leaves did not have the morphology typical of *Stylites*, the leaves of plants collected from hummocks invariably had the typical form, and some of these were as long as 5.5 cm. According to Rauh and Falk, the stem of *S. andicola* is mostly unbranched and up to 20 cm long, whereas that of *S. gemmifera* is frequently branched and not more than 8 cm long; obviously these characters would be of no use in identifying an unbranched plant whose stem was not more than 8 cm long. Also, *S. andicola* is supposed to form hummocks in which all individuals are the same age, whereas colonies of *S. gemmifera* contain both old and young plants. Although they did not explicitly state their method, Rauh and Falk seem to have used size as an indicator of relative age. In any case, the hummocks which contain unbranched plants of a uniform large size and no gemmae (i.e., hummocks of "*S. andicola*") may simply

be relatively old colonies in which the intense competition for space has been resolved in favor of the largest and most vigorous individuals which neither branch nor produce gemmae. The only qualitative distinction between the sporophytes of the two species of *Stylites* is the presence of gemmae in *S. gemmifera* and their absence in *S. andicola*. However, the number of gemmae on a plant is highly variable. In our material, from one to eight were seen, and many plants had no gemmae at all. According to the criteria given by Rauh and Falk, sporophytic specimens without gemmae and with stems shorter than 8 cm may be distinguished as to species only by the length of their leaves. Unfortunately, as noted above, we have gemma-bearing plants, obviously assignable to *S. gemmifera*, which have leaves longer than 5 cm. Thus it appears to us that the distinctness of the two species of *Stylites* is in sufficient doubt that a critical reexamination of these two taxa is in order. Moreover, inasmuch as the separation of *Stylites* from *Isoëtes* already has been questioned (Kubitzki & Borchert, 1964; Bierhorst, 1971), this reexamination also should review the generic assignment of these species.

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